

Geologic Landscape and Coastal Assessments Subactivity

Program	1999 Estimate	Uncontrol. & Related Chgs	Program Redirect	Program	FY 2000 Budget Request	Change from 1999
Earth Surface Dynamics	13,555	306	-4,036	0	9,825	-3,730
National Cooperative Geologic Mapping	22,546	566	-3,231	1,500	21,381	-1,165
Coastal and Marine Geology	37,990	744	-6,339	-2,900	29,495	-8,495
Total Requirements \$000	74,091	1,616	-13,606	-1,400	60,701	-13,390
Note: The Program Redirect column reflects the redirection of funds to the Integrated Science, Science Support, and Facilities activities.						

Coastal and Marine Geology

Current Program Highlights

The Coastal and Marine Geology Program is addressing a broad array of coastal and marine issues that are grouped in the themes of: environmental quality, natural hazards and public safety, natural resources, and technology and information. Dealing with and solving these national issues requires the credible science results being provided by the USGS. The program balance results from following a 5-year plan of research based on prioritization of national issues and customer needs. This plan is flexible and includes about 50 interdisciplinary studies that are producing information and products used on a daily basis by Federal, State, and local agencies and the public as the authoritative, credible, objective scientific basis for regulating, managing, and protecting the Nation's coastal and marine resources.

Environmental Quality and Preservation — These USGS studies address pollution and waste disposal, wetlands loss, characterization of biological habitats and marine reserves, and environmental change. Results from these efforts are providing an understanding of geologic processes needed to predict natural and human-related variability and to evaluate the influence of human activities on coastal regions, estuaries and the offshore. Land-management decisions by public agencies and private groups routinely use the regional broad-based and long-term science information produced by this USGS work.

Natural Hazards and Public Safety — These USGS investigations provide geologic information for understanding and predicting coastal erosion and other storm effects on the

shoreline, for identifying evaluating offshore earthquake and tsunami hazard potential, and for evaluating submarine landslide hazards. Studies address geologic history and processes, including studies of regional stratigraphy, subsurface structure, and the geologic setting, that provide the scientific foundation for forecasting and mitigating the effects of coastal hazards.

Natural Resources — These collaborative studies by the USGS provide information to States, Federal agencies, and industry on the location, distribution, quantity, and quality of fresh water, mineral, and energy resources in marine environments, and the potential impacts of extraction. In addition to marine areas containing future resources, understanding the conditions and processes which form energy and mineral deposits is important because the marine environment is the modern analog for older deposits being recovered on land.

Technology and Information — These USGS efforts provide basic products about the form and composition of the Nation's coasts and seafloor through systematic reconnaissance-level surveys and production of maps of the U.S. Coast and Exclusive Economic Zone. These maps and scientific information are used for assessment and management of the sea floor and provide a foundation for investigations of environmental-, hazard-, and resource-related issues in coastal and offshore areas. The USGS also addresses the management and transfer of marine geologic information and products. In addition to producing a wide array of traditional products, information on the Coastal and Marine program and results from the studies are rapidly disseminated over the World Wide Web at <http://marine.usgs.gov/>.

Recent Accomplishments

Environmental Quality

Geologic Controls on Coral Reef Systems — Coral reefs are critical ecosystem habitats in the U.S. and in many tropical developing-nations and these reefs are in dramatic decline due to a combination of natural and man-made factors. Reefs provide enormous advantages with their biodiversity, protection against wave forces, beauty and cultural relevance, manufacture of sands for adjacent beaches, appeal to tourists, and importance for recreational and commercial fishing. Changes in water quality, adjacent land usage and drainage, coastal construction, over fishing, ship groundings, and proliferation of diseases, are placing coral reefs at risk. Coral reef research and thematic mapping are necessary and the USGS has begun a scientific study coordinated with other Federal agencies (NPS, FWS, NOAA, NASA).

This project is assessing change induced by natural and anthropogenic causes by mapping the location and evaluating the health of coral reefs, discerning the impact of sedimentation, including airborne dust and diseases, and wave energy on reef diversity and succession. Geologic studies determine the nature and timing of changes in reef growth during the past few hundred years. This characterization is key to relating present coral composition to that of the historic reef, determining the effects of sea-level change, and sorting out human effects from the natural evolution of reefs. Two main investigations are being conducted in cooperation with the University of Hawaii and others: Mapping Investigations and Geologic Process Studies. Using laser and multi/hyper-spectral imagery and aerial photography, unprecedented detailed mapping is producing maps of bathymetry and photographic images. Two investigations in Florida evaluate sources of water that impact coral reefs. One uses

satellite imagery and salinity surveys to document the flow of water from Florida Bay and the Florida Keys and its impact on reefs in several DOI and NOAA parks: Biscayne National Park, the Florida Keys National Marine Sanctuary, and Dry Tortugas National Park. Results show that net ground-water flow and contaminants is from the Bay toward the reefs at higher rates than previously thought.

This project is providing reef managers a better understanding of the controls that influence coral reefs, regional diversity, distribution and productivity. The information is being routinely used by State and Federal managers in Hawaii and Florida, and also to U.S. Territories and island nations to balance protection of reefs with the activities of a growing human coastal population and development.

Geology and Processes of the Lake Pontchartrain Basin, Louisiana — One of the largest and most important estuaries of the Gulf Coast region, the Lake Pontchartrain Basin, is adjacent to New Orleans, a city of 1.5 million people. The effects of the area's rapid development over the past 50 years combined with natural processes have resulted in significant loss of critical habitat (wetlands) and environmental degradation. To better understand the Basin's origin and the processes driving its evolutionary development and degradation, a multidisciplinary study has been undertaken in close collaboration with Louisiana state institutions and other Federal agencies. Six primary tasks are being addressed: geologic framework, historic shoreline and wetland change, lakebed sediment characterization, critical processes, circulation modeling, and information transfer/education outreach. Such baseline information is being used by state and local managers to protect and restore the Pontchartrain Basin.

There is growing public and political concern about a number of environmental issues affecting Lake Pontchartrain Basin. The main issues detailed in the USGS plan are pollution of lakebed sediments and shoreline erosion/wetland loss. Other secondary issues are shallow faulting, effects of commercial shell dredging, and saltwater intrusion into aquifers used for public water supply. High quality scientific knowledge about the Basin's geologic character and estuarine processes has been limited. The goal of this project is to gather and analyze baseline data and disseminate the results to a broad user community.

Sediment and Pollutant Movement Offshore Los Angeles — The urban ocean offshore of the Los Angeles metropolitan area receives surface runoff, sewage, and industrial drainage. Recent surveys have shown that more than 95 percent of Santa Monica Bay, west of Los Angeles, has contaminants at concentrations exceeding levels at which biological effects begin to occur. The USGS, in collaboration with the city of Los Angeles and the Southern California Coastal Water Research Project, is conducting a study of the sediments on the floor of Santa Monica Bay to determine the severity of present contamination conditions and how levels of contamination have changed in recent times.

The USGS obtained a set of sediment samples going back over the last 100 years. Sediment from each of these dates was tested for geologic properties, pesticides, toxicity, and other contaminants. Analysis of these data show that, although surface sediment in the Bay is still contaminated, contamination levels have decreased over the past 50 years. Overall, conditions of sediment contamination in the Bay are improving. In addition, sediment data are being combined with monitoring of ocean currents to better understand how sediment and

contaminants move around the Bay. This information is having immediate benefits to state and local agencies involved with cleaning up and managing the offshore.

Long Island Sound Contamination and Habitats — USGS studies being conducted in cooperation with the Connecticut Department of Environmental Protection have defined the seafloor processes, hydrodynamics, and contaminant distributions in the large, urbanized Long Island Sound estuary. This new suite of data provides a comprehensive regional understanding of the long-term fate and transport pathways of human toxins and wastes introduced into Long Island Sound. Results show that contaminants are widely dispersed across the Sound and that contaminant levels closely follow the distribution of muddy sediments. Seafloor environments, the proximity to pollutant sources, and the mixing of bottom sediments also influence the contaminant distribution. Knowledge of the variability of contaminants and seafloor conditions is essential to Federal, State, and local environmental managers for predicting where contaminants and wastes affect the seafloor biologic habitats and determining where additional studies are needed.

Understanding the Chesapeake Bay Ecosystem — USGS scientists are working with EPA, state agencies, universities, and marine laboratories in the Chesapeake region to put understanding the Bay's ecosystem into a historical context. Studying written records and working back in time with information from sediment cores, investigators are starting to see how the Bay has responded to rising sea level and changing climate over past decades and centuries. These data are being matched and compared with other archived information of the past including tree ring records and sediment cores from East coast lakes and the Atlantic Ocean.

This information is being used to assess scenarios for the future of the ecosystem and to optimize management strategies of Chesapeake Bay Program partners to reduce negative human impacts to the ecosystem. In 1998, major field investigations were performed including imaging of underwater sediment layers and sediment coring in the main Bay, tributaries, and marshes. Careful analyses of the sea-level change record is underway and results show that sea level is rising much faster than the world-wide average, which has grave implications for developed coastal regions around the Bay.

Hazards

Mapping the Effects of El Niño Storms on the Pacific Coast — As part of its response to El Niño generated storms and coastal response, the USGS and its Federal partners collected airborne laser baseline topographic survey data (LIDAR) along 1200 km of the U.S. Pacific Coast. The joint USGS, NOAA, and NASA surveys were conducted during October 1997 and April 1998. The primary purpose of the investigation was to document beach and coastal bluff changes as a result of severe El Niño induced winter storms. Highlights of the LIDAR data include an area along the central Washington coast that underwent 130 m of shoreline erosion, an area along northern California showing shoreline accretion of 120 m, massive coastal landslides north of San Francisco, and many examples of cliff and dune erosion of 15 to 20 m.

Additional studies, in cooperation with State, local, and university researchers, further established the timing and process mechanisms of coastal change at a number of detailed study sites along the West Coast. Coastal monitoring, which included oceanographic measurements, beach profiling and aerial photography, is being used by state and local agencies to reduce the costs and threats posed by extreme climate events.

Earthquake Hazards of the Pacific Northwest Coastal Region — A complimentary mix of geologic investigations by the USGS is being used to improve the scientific understanding of onshore and offshore fault structures and potential slope instabilities associated with the tectonic deformation of coastal Washington. The results of these USGS studies are being used to update regional fault maps of the Puget Sound region and the Washington-Oregon coastal zone. Additionally, the data provide new and dramatic information to FEMA and state agencies on the magnitude potential and reoccurrence rates of earthquakes and tsunamis and the impact of these events on man's activities in the Seattle-Tacoma urban corridor.

These data are also serving as the basis for predictive USGS maps of earthquake acceleration, velocity, and intensity amplitude. Sedimentologic, geotechnical, and paleontologic data are being used to assess the reoccurrence rates of seismic events to enable development of improved probabilistic seismic hazard evaluation maps. Together, these data are used by local and regional planners and managers to prepare for future earthquakes in the Cascadia region of the Pacific northwest.

Coastal Landslides in the Great Lakes Region — Offshore geological studies conducted by the USGS, in cooperation with the National Park Service, have shown that major landslides along the floor of Lake Michigan have caused rapid and catastrophic shoreline loss at Sleeping Bear Dunes National Lakeshore that threaten life and property. These slides, over a period of centuries, have disrupted the beach and parts of the lakefloor. Onshore studies discovered underlying geology that predisposes the area to land sliding, and documented beach loss and ground pressures; interpretations of these findings are helping to understand the cause of repeated slides. Results of underwater surveys and onshore monitoring are helping USGS and the NPS evaluate the landslide hazard potential in the Park and may have application to other regions.

Southwest Washington Coastal Erosion — Over the past several thousand years, the beaches of southwest Washington and northwest Oregon accumulated sand, growing seaward and creating broad coastal plains and dune fields. During the last century, accelerated accretion of the beaches, associated with jetty construction at tidal inlets, has led to the belief that the coast was stable and favorable for development. In the past few decades, however, beach accretion has slowed, and in several areas has reversed to erosion, causing loss of land and property damage. Scientists from the USGS, the state of Washington, and local agencies are conducting a comprehensive, regional study of sediment supply, coastal processes, and shoreline change in the Columbia River coastal region that is having immediate benefit in dealing with these issues.

Scientists are learning that the position of the shoreline changes over many time scales and due to many factors, including seasonal fluctuations of up to 100 m during winter, reorientation of the shoreline during El Niño storm events, and infrequent but catastrophic tsunami waves following earthquakes. All of these shoreline events are superimposed on longer-term trends

of either accretion or erosion. This information is aiding State and Federal agencies that are responsible for managing coastal activities, as well as local government officials responsible for long-term planning of coastal development and protection.

Resources

Sand Resources Offshore Long Island to Mitigate Erosion — The serious and widespread coastal erosion along the barrier-island system along the south shore of Long Island, New York, is receiving much attention. The economic importance of this area is substantial. Approximately \$2.8 billion worth of private real estate, coupled with a \$1.5 billion annual tourist industry, is dependent on the region's Federal, State, county, and local recreational beaches that are undergoing rapid erosion. The USGS, in cooperation with the U.S. Army Corps of Engineers, is producing geologic maps of the sea floor along the south shore of Long Island that are providing immediate benefit.

The goals of the project are to determine regional-scale sand resource availability for planned beach-nourishment programs and to investigate the role that inner-shelf morphology and geologic framework play in the evolution of this coastal region. Mapping results show that the inner shelf is an expression of underlying geology and glacial history, as well as oceanographic processes acting on the seafloor during sea-level rise. Modern sediment deposits on the inner shelf, a potential sand resource, were formed from erosion of headlands areas during recent sea level rise. This information is being used by the Corps of Engineers to assess sand resource potential and evaluate the possible impact that extraction of this resource might have on adjacent beaches. In addition, USGS products are being used by NPS and FWS, State, and local planners to evaluate coastal erosion mitigation options.

Geologic Processes Shaping the Deep-water Gulf of Mexico — The continental slope offshore of Texas and Louisiana is one of the few remaining frontier regions for oil and gas exploration within the U. S. Exclusive Economic Zone. The USGS is conducting research in cooperation with academic institutions to map the near-surface geology to better understand the processes that have shaped this geologically dynamic area. A regional mapping effort is providing information on the geometry and lithology of modern slope deposits and the distribution and timing of submarine landslides. This project, in cooperation with the USGS Methane Hydrates Project, is studying the distribution of gas hydrates in the Gulf of Mexico and the relation of hydrates on seafloor processes.

These studies are providing MMS, other Federal agencies, and the oil and gas industry with critical information on the impacts of oil and gas extraction in the deep Gulf of Mexico. The hazards being identified and mapped influence the siting of platforms and pipeline routes. The detailed understanding of the geometry and composition of modern slope deposits also provides industry with analogs to more deeply buried deposits that presently are drilling targets; information needed for their oil and gas exploration and extraction studies.

Information and Technology

Geologic Mapping of Nearshore Seafloor Habitats — Accurate base maps are a prerequisite for nearly every geographically based scientific study. Detailed knowledge about seabed habitats does not exist for most of the Nation's coastal regions, yet seabed geology is the basic framework for the development of habitats and associated biological resources. The mapping and evaluation of habitats is a high priority of Federal and State agencies that manage marine resources. USGS, in cooperation with the University of New Brunswick and using private sector ocean-surveying firms, has begun the systematic mapping of large portions of the U.S. continental margin. This effort is producing accurate, high-resolution base maps and imagery for geologic and biologic studies by the USGS and other agencies. The EPA, U.S. Army Corps of Engineers, and NOAA, among others have joined with the USGS to support this mapping. They are using the data for activities as diverse as regulating marine disposal sites, decisions concerning the removal of navigation hazards, and management of the Nation's National Marine Sanctuaries.

In the past few years, the USGS mapped parts of the continental margin off greater Los Angeles and San Diego, selected areas around the Hawaiian Islands, including the Humpback Whale Marine Sanctuary; Flower Garden Bank; Stellwagen Bank; parts of Monterey National Marine Sanctuary; parts of the New York Bight, including the Hudson Shelf Valley; Gulf of Maine; and central San Francisco Bay. In 1998, the USGS brought marine mapping technology onto the continent, successfully mapping the complex bottom of Lake Tahoe to address a variety of environmental issues associated with the Lake. The coastal maps and related research on biological habitats have identified bottom types that are deemed essential for the successful reproduction and survival of important fishery species and have documented the alteration of "essential fish habitat" by fishing practices. Maps of both active and historical disposal sites have documented the dispersal patterns and the effects of the materials on the environment, and the status of toxic sites that have been capped to prevent further contamination of the seabed.

These results are providing a basis for further research and for the development of regulatory policies by State and Federal managers. For instance, the maps are used by the EPA and the USACE to manage offshore disposal sites; and by NOAA, the regional Fisheries Management Councils, and the fishing industry to identify "essential fish habitat" and to regulate fishing grounds. Future marine mapping will continue adjacent to the major population centers on the East and West coasts and possibly the Great Lakes.

Coastal Assessment — The goal of this study is to provide credible information on coastal erosion and accretion and other coastal processes needed to make decisions by coastal planners and managers at the State and local level. A number of USGS regional erosion studies have been completed over the past years. The result has been a substantial expansion of the data and knowledge related to, in particular, coastal erosion and storm impacts. The coastal assessment effort is making this information readily available by synthesizing the data, which include historical information, and combining information from the USGS with outside data, including large-scale mapping efforts and event-specific response studies (hurricane and El Niño events). Development of computer tools and formats which best meet the needs and capabilities of the widest range of end-users are underway. Initial efforts, centered around coastal erosion issues and focused on South Carolina, are providing a model for the data compilation effort. Ongoing model development to enhance the data value by providing predictive models of erosion and storm impact are critical to the success of this

effort. In the future, coastal assessments will broaden to encompass the full range of resource, environmental, and hazard-related issues facing coastal-zone managers.

Justification for Program Change

Coral Reef (+\$0.6 million) — In response to recent evidence that indicate coral reefs are deteriorating worldwide, President Clinton signed Executive Order 13089 establishing the U.S. Coral Reef Task Force. The Executive Order calls for the protection of coral reefs through comprehensive program of inventory and mapping, monitoring, and research into the causes of their decline. This \$600,000 increase will enable a modest increase of coral reef studies to gather information on the extent and character of reef ecosystems nationwide. These studies will be used to map coral reefs and expand on existing activities to define the natural processes related to reef health and growth and the effects of man's activities and natural processes causing the widespread decline in reef health.

	FY 2000 Request	Program Change
\$(000)	29,495	-2,900

Proposed Reduction (-\$3.5 million) — Funding will be redirected for higher priorities from the following activities that are nearing completion: a phase I study of the processes and conditions responsible for coastal erosion along the coastlines of South Carolina and Georgia; major studies of the Louisiana barrier islands, wetlands and Lake Pontchartrain; and studies regarding four National Marine Sanctuaries. In addition, investigations of offshore earthquake, landslide, and tsunami hazards along the southern Pacific coast will be curtailed; and lower priority surveys and assessments of the Nation's offshore marine mineral resources would be terminated.